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B. Length of loxodromics from equator and zero-meridian to meridians 90, 180, 270, 360 in miles.

Longitude.	Length of Loxodromic.
0	0
90	3247
180	4152
270	4344
360	4384

The entire length of the loxodromic is  $S = \sqrt{(2)\frac{1}{2}\pi.R} = 8788$  miles, which is obtained by putting in (9)  $b=0$ , or in (11)  $\varepsilon=\infty$ . This result coincides with the one obtained in the first table, where the length of the loxodromic for the latitude of  $90^\circ$  is also 8788 miles.

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## DEPARTMENTS.

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### SOLUTIONS OF PROBLEMS.

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#### ARITHMETIC.

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114. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy, Irving College, Mechanicsburg, Pa.

Does it pay a \$4-carpenter using a dozen four-penny nails per minute, to pick up a dropped nail? At this rate, should twenty-penny nails be picked up?

Solution by B. F. FINKEL, A. M., M. Sc., Professor of Mathematics and Physics, Drury College, Springfield, Mo.

The price of four-penny nails, at the present time, is 5 cents per pound. Assume that there are 200 nails to the pound, and that it takes the carpenter 10 seconds to pick up a nail.

The value of a nail is  $\frac{5}{200}$  of a cent, or  $\frac{1}{40}$  of a cent.

If we assume that the carpenter gets \$4.00 per day, and works 10 hours in a day, his wages is 40 cents per hour, or  $\frac{1}{90}$  of a cent per second.

Hence, 10 seconds, the time required to pick up a nail, is worth  $\frac{1}{9}$  of a cent.

Hence, since the value of the nail picked up is only  $\frac{1}{40}$  of a cent, it does not pay the carpenter to pick up the nail, he losing thereby  $\frac{1}{9} - \frac{1}{40}$  or  $\frac{31}{360}$  of a cent.

It would not pay to pick up twenty-penny nails at the same rate.

115. Proposed by ALOIS F. KOVARIK, Instructor in Mathematics and Physics in Decorah Institute, Decorah, Ia.

Where shall a pole 120 feet high be broken so that the top may rest on the ground 40 feet from the foot? (Solve by arithmetic.)

I. Solution by M. A. GRUBER, A. M., War Department, Washington, D. C.

A.  $40 = \text{base}$ , and  $120 = \text{sum of altitude and hypotenuse of a right-angled triangle}$ .

$(120^2 \pm 40^2) \div 120 = 133\frac{1}{3}$  and  $106\frac{2}{3}$ , which are, respectively, two times the hypotenuse, and two times the altitude.

$\therefore \text{Hypotenuse} = 66\frac{2}{3}$  feet, and altitude  $= 53\frac{1}{3}$  feet.

$\therefore \text{The pole must be broken } 53\frac{1}{3}$  feet from its foot.

B.  $40 = \text{base}$  and  $120 = \text{sum of altitude and hypotenuse of a right-angled triangle}$ .

Since one of the sides and the sum of the other two sides are rational, each of the sides must be rational.

Also, prime, integral right triangles are the basis of all composite and fractional rational right triangles.

We observe that the base is one-third of the sum of the other two sides. This is the case with *one right triangle of prime, integral sides*, of which the base  $= 3$ , altitude  $= 4$ , and hypotenuse  $= 5$ .

$40 = 13\frac{1}{3}$  times 3.  $\therefore$  The altitude and hypotenuse of the required right triangle are, respectively,  $13\frac{1}{3} \times 4$ , and  $13\frac{1}{3} \times 5$ , or  $53\frac{1}{3}$  and  $66\frac{2}{3}$ .

$\therefore \text{The pole must be broken } 53\frac{1}{3}$  feet from its foot.

II. Solution by COOPER D. SCHMITT, A. M., Professor of Mathematics, University of Tennessee, Knoxville, Tenn.; ELMER SCHUYLER, Annapolis, Md.; P. S. BERG, B. Sc., Larimore, N. D.; H. C. WHITAKER, Ph. D., Professor of Mathematics, Manual Training School, Philadelphia, Pa., and G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa.

$AB = 120$  feet,  $BC = 40$  feet. Since  $CD = AD$ ,  $\angle CAD = DCA$ .

Hence (geometrically), construct a right triangle with base 40 and perpendicular 120, and join  $AC$ . At  $C$ , make an angle equal to  $CAB$ , and this will give  $D$ , the required point.

Algebraically:  $AD = CD = x$ ,  $BD = y$ , and we have at once  $x + y = 120$  ..... (1),  $x^2 - y^2 = 1600$  ..... (2). Dividing (2) by (1) we have  $x - y = 13\frac{1}{3}$ .

Whence  $x = 66\frac{2}{3}$ , and  $y = 53\frac{1}{3}$ .

III. Solution by CHARLES CARROLL CROSS, Whaleyville, Va.

A rule, which can easily be established by geometry for solving such problems is as follows: Divide the difference of the squares of the height of the pole and the distance on the ground by two times the height, which will give the part standing. Thus height  $= (120^2 - 40^2) / 2 \times 120 = 53\frac{1}{3}$  feet.

[Is this an arithmetical solution? C. C. C.]

116. Proposed by J. O. MAHONEY, B. E., M. Sc., Professor of Mathematics and Science, Cooper Training School, Carthage, Tex.

Two candles are of the same length. The one is consumed uniformly in 4 hours, and the other in 5 hours. If the candles are lighted at the same time, when will one be three times as long as the other?